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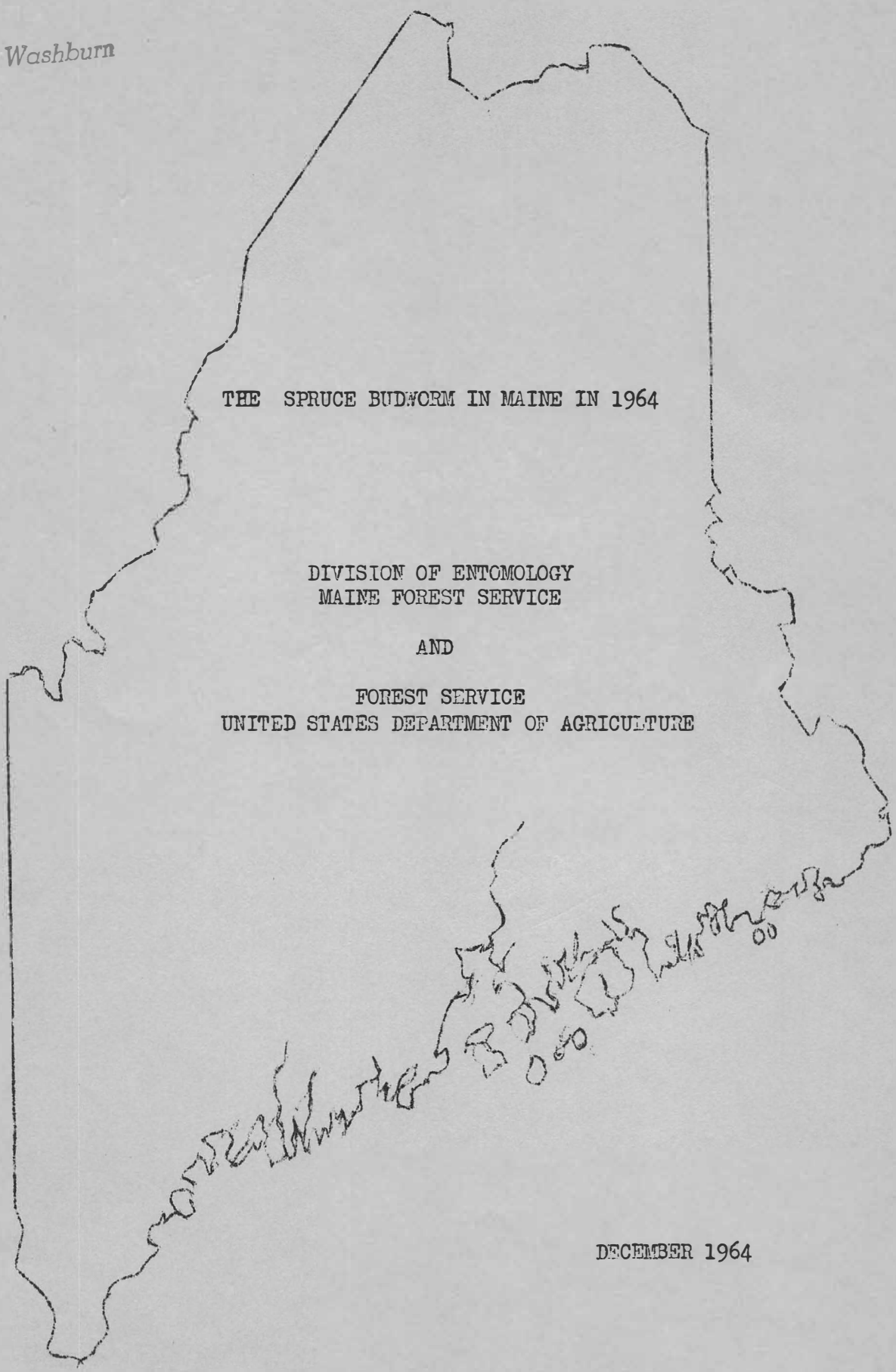
THE SPRUCE BUDWORM IN MAINE IN 1964

DIVISION OF ENTOMOLOGY
MAINE FOREST SERVICE

AND

FOREST SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE



DECEMBER 1964

1. INTRODUCTION

After consideration of the 1963 spruce budworm data and field conditions, entomologists of the Maine and U. S. Forest Services recommended a control operation to reduce the spruce budworm population in the "Oxbow Area" both to protect weakened trees and to protect the 1963 control area from the possibility of reinfestation. In addition it was recommended that several small areas of remaining heavy population be treated.

Field work associated with timing 1964 spray application, assessment of the results, and regular surveys for forecasting conditions in 1965 were directed as usual from field laboratories at both Portage and Sinclair. Areas of negligible infestation, remote from the field laboratories, were given coverage by means of the regular insect collections of the fire warden force and the various light trap stations. Collections sent to Portage, Sinclair, or Augusta from which spruce budworm were obtained during 1964 are shown cartographically (Fig. 1).

2. THE 1964 CONTROL OPERATION

The largest part of the 1964 control operation was in the "Oxbow Area", north of the Salmon Pool and Oxbow flats in T9R7, T10R7, and Oxbow. Other areas treated were southwest of Portage Lake along the Anderson Road, north of Portage Lake near Nixon Siding, and between Portage Lake and Square Lake in T14R6, T14R5, T15R6 and T15R5 around the "Old Chain Bridge", McClusky Lake, and Goddard Brook. Additional acreage added during the project resulted in joining together several of these previously separate areas (Fig. 2). A total of 58,100 acres were treated.

Headquarters for the operation, under the direction of the State Entomologist, were again at the old Air Force Base at Presque Isle. The usual DDT insecticide was applied in two treatments, each of ½ lb. DDT in ½ gal. oil solution per acre, except for areas around ponds and rivers. Around ponds the first 100 ft. were left unsprayed, the next 100 ft. were sprayed only once with the ½ lb. dosage. Major rivers received only the latter treatment for 200 ft. along each shore. Spraying began on May 29th and continued until June 14th. Seventeen spray periods involved 28 hours of actual spraying time or a total of 72 spray hours for three spray planes; the difference being due to some spray planes not operating full time. Direct costs were $1.34 per acre with total costs of $1.55 per acre (direct and indirect). Funds (private and State) remaining from the 1963 project monies were sufficient for 1964 and approval was obtained for cooperative Federal Forest Pest Control funds. Distribution was private and State, each 36% and Federal 28%. Contract was awarded to Richardson Aviation Co., Yakima, Washington, for two TBM and one Stearman aircraft with necessary personnel, at a price of 55¢ per gallon of spray applied. Separate arrangements were made for other necessary planes and personnel. Insecticide, plus some storage and loading equipment, came from Forest Protection Ltd. as usual.

A more complete and detailed report of this phase of the program is contained in FOREST PEST NOTES, No. 1 of 1964, available from the Division of Entomology, Maine Forest Service.

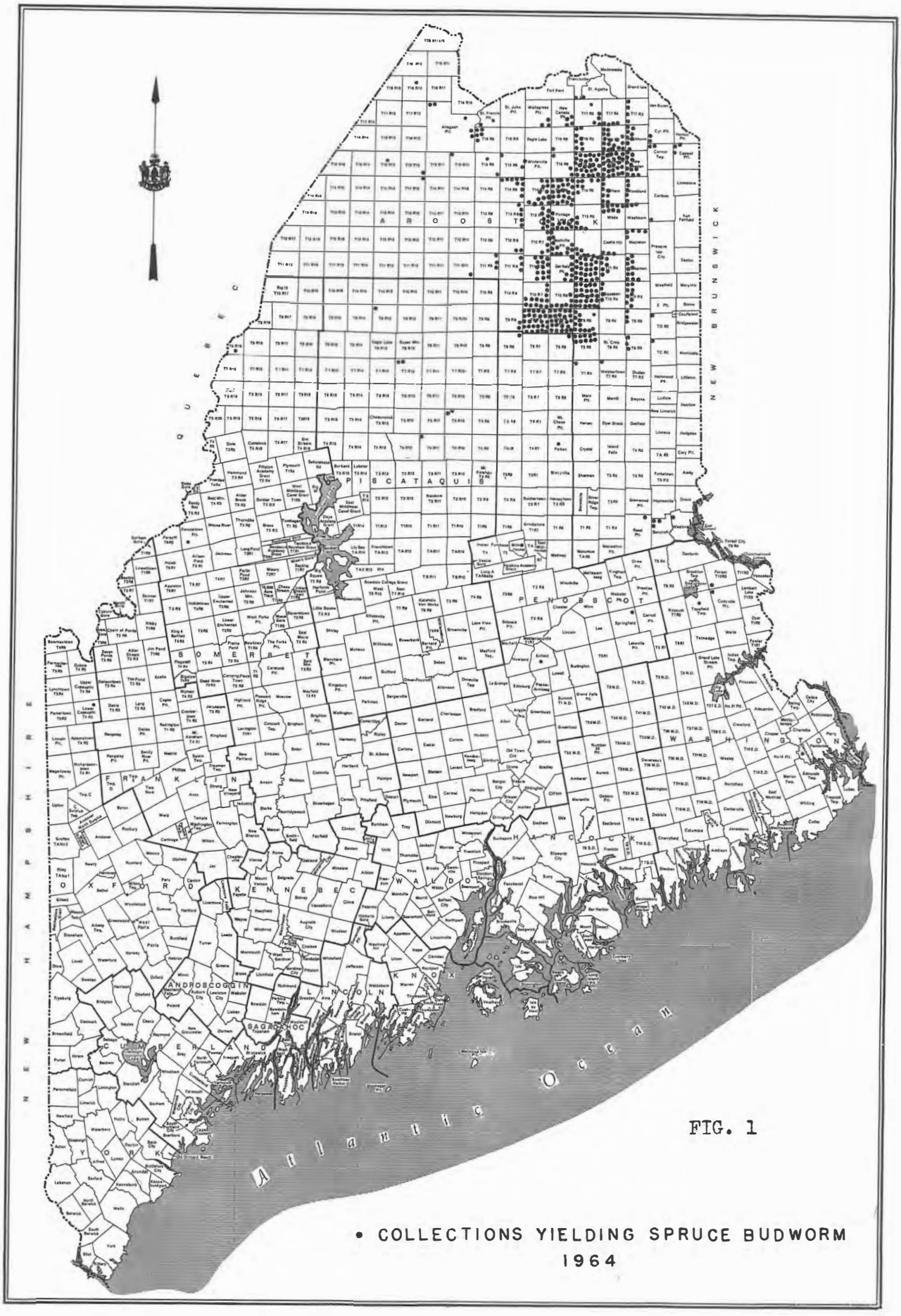
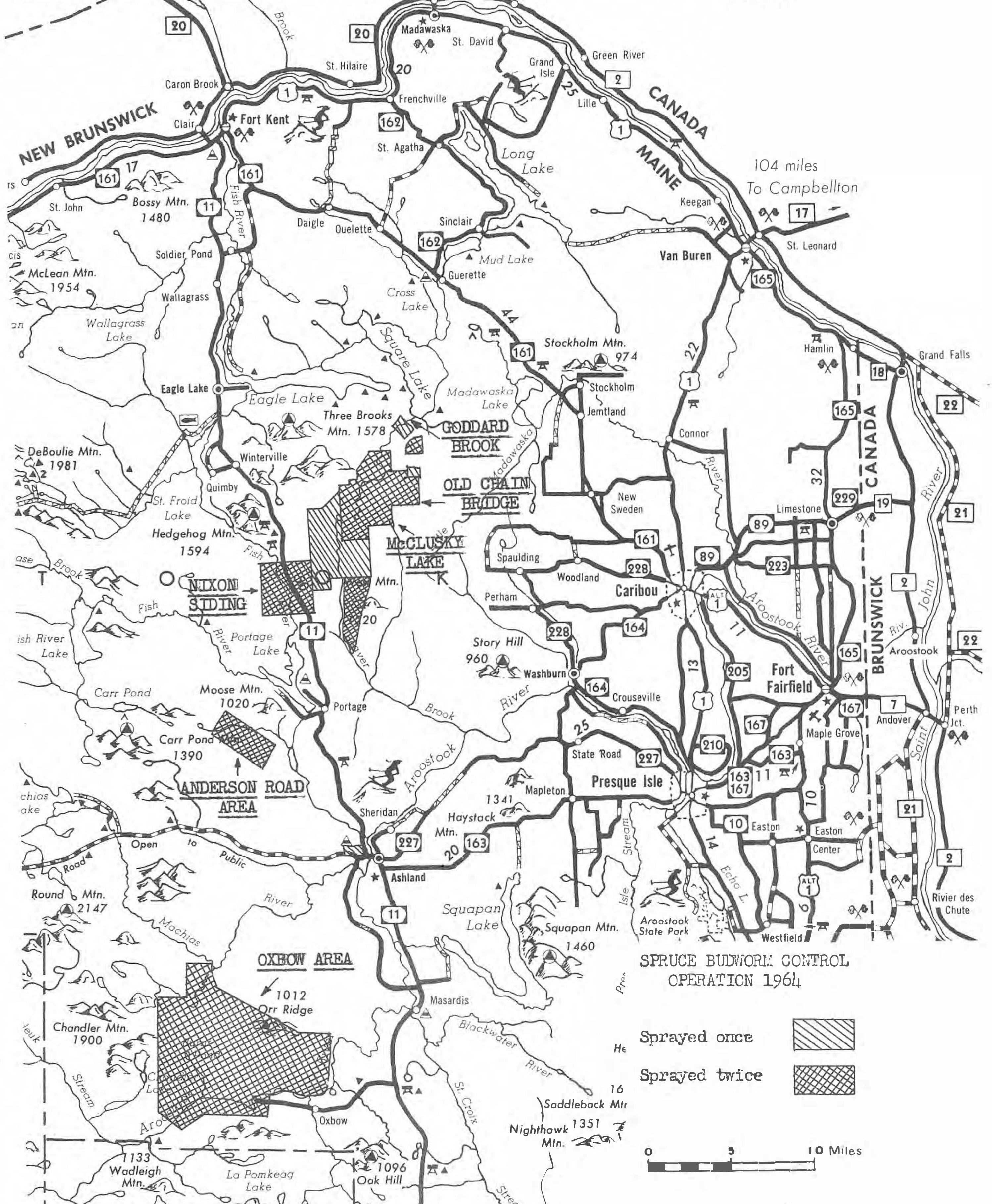


FIG. 1

• COLLECTIONS YIELDING SPRUCE BUDWORM
1964

FIG. 2


SPRUCE BUDWORM CONTROL OPERATION 1964
Sprayed once
Sprayed twice
0 5 10 Miles
GODDARD BROOK
OLD CHAIN BRIDGE
McCLUSKY LAKE
NIXON SIDING
ANDERSON ROAD AREA
OXBOW AREA
NEW BRUNSWICK
CANADA
MAINE
104 miles To Campbellton
Edmundston
St. Basil
Madawaska
St. David
Grand Isle
Green River
St. Hilaire
Caron Brook
Frenchville
Lille
Clair
Fort Kent
St. Agatha
Long Lake
St. John
Bossy Mtn. 1480
Daigle
Ouelette
Sinclair
Keegan
Van Buren
St. Leonard
Soldier Pond
Mud Lake
Guerette
McLean Mtn. 1954
Wallagrass
Cross Lake
Wallagrass Lake
Square Lake
Stockholm Mtn. 974
Hamlin
Grand Falls
Eagle Lake
Stockholm
Madawaska Lake
Jemtland
Three Brooks Mtn. 1578
Connor
DeBoulie Mtn. 1981
Winterville
Quimby
St. Froid Lake
New Sweden
Limestone
Hedgehog Mtn. 1594
Spaulding
Woodland
Caribou
Perham
Fish River Lake
Portage Lake
Story Hill 960
Washburn
Fort Fairfield
Aroostook
Carr Pond
Moose Mtn. 1020
Portage
Crouseville
Carr Pond Mtn. 1390
State Road
Maple Grove
Andover
Perth Jct.
Presque Isle
Mapleton
1341 Haystack Mtn.
Sheridan
Easton
Easton Center
Open to Public Road
Ashland
Round Mtn. 2147
Squapan Lake
Squapan Mtn. 1460
Aroostook State Park
Westfield
Rivier des Chute
1012 Orr Ridge
Masardis
Chandler Mtn. 1900
Blackwater River
Saddleback Mtn
Nighthawk Mtn. 1351
Oxbow
1133 Wadleigh Mtn.
La Pomkeag Lake
1096 Oak Hill

3. LARVAL SURVEYS

Collections of fir and spruce foliage taken to the two field laboratories served a number of purposes. A final check, prior to the control operation, confirmed the predictions of 1964 infestations made from the 1963 egg mass survey. Information was obtained for timing the spray applications with respect to fir, spruce, and budworm development. Collections made just prior to the control operation and afterward were used to assess results. It was possible to pick up additional areas of infestation in time to include them in the control operation. Studies of the spruce budworm parasites were continued with dissections and rearings from the early and late larval-pupal collections respectively.

4. RESULTS OF THE CONTROL OPERATION

Results of the 1964 control operation are shown in Table 1. Comparisons are made with the 1963 operation since spray methods were similar and results were judged in the same way. It will be seen at once that control was not as good in 1964, compared with 1963. This result is in keeping with observations of field crews who saw more surviving budworm in some spray areas than would normally be expected. Most such observations were made in the Oxbow area, in that part of the area where operations were completed first. The survival data, when separated by area (Table 2.) also suggest that the poorer control was restricted to the earlier treated area. Nevertheless an adequate degree of control was obtained, with populations, on the average, reduced below those in the lightly infested, unsprayed areas (Table 3.). Thus the operation can be regarded as successful and having accomplished its purpose.

It seems useful to speculate on the reasons for somewhat poorer control in 1964. Figure 3 compares the rate of spruce budworm development in 1963 and in 1964 together with some significant dates in the spray operations. It appears that 1964 was a very different year with development proceeding more slowly than in 1963 although a warm period earlier in the spring of 1964 gave the budworm an earlier start.

In 1963 the spray operations began on June 4th when approximately 40% of the budworm larvae were in the 5th instar and developing swiftly. Data are lacking on the development of the 5th and 6th instars since all known areas of sufficient budworm for reliable larval development collections were sprayed. Operations were completed on June 19th. The first pupae had been found on the 17th and by the 20th, 9% of the budworm had become pupae. Thus operations had been started near the traditional time for spraying in Maine and carried on right up to pupation. In retrospect it seems that timing was ideal in consideration of the large project and many operational problems. The second spray application occurred at about the right time for maximum kill and the earlier application saved much foliage.

TABLE 1. Comparison of Spruce Budworm Survival [1.] based on early larval and late larval-pupal collections made just before and just after spraying. Number of sample points indicated in brackets.

	Survival	
	1964	1963
Sprayed area, two treatments, balsam fir	0.026 (20)	0.010 (19)
Sprayed area, one treatment, balsam fir	---	0.027 (4)
Sprayed area, two treatments, red spruce	0.132 (9)	0.110 (7)
Unsprayed area, balsam fir	0.605 (45)	0.665 (15)

Percent reduction in survival as a result of spraying [2.]

	1964	1963
Two treatments, balsam fir	95.7	98. 5

1. Survival = $\frac{\text{Number of large larvae and pupae}}{\text{Number of small larvae}}$

2. Percent reduction in survival as a result of spraying(using Abbott's formula)

$$= 100 \times \frac{(\text{survival in unsprayed area}) - (\text{survival in sprayed area})}{(\text{survival in unsprayed area})}$$

TABLE 2. Comparison of Spruce Budworm Survival in different parts of the 1964 Spray Area. No. of sample points indicated in brackets.

	Survival
1. Oxbow area, in that part of the area where the second spray application was completed early	0.033 (11)
2. Oxbow area, in that partof the area where the second spray application was completed later	0.009 (3)
3. Old Chain Bridge area (completed later)	0.000 (1)
4. McClusky Lake area (completed later)	0.015 (2)
5. Nixon Siding area (completed later)	0.002 (3)
6. All areas taken together (weighted by population density	0.026 (20)

(all samples from balsam fir)

TABLE 3. Average number of spruce budworm per 15-inch twig after spraying

	1964	1963
1. Balsam fir, sprayed twice	0.47	0.23
2. Balsam fir, sprayed once	--	0.44
3. Red spruce, sprayed twice	1.32	1.54
4. Balsam fir, unsprayed [1.]	1.87	1.89

1. Outside areas of heavy infestation.

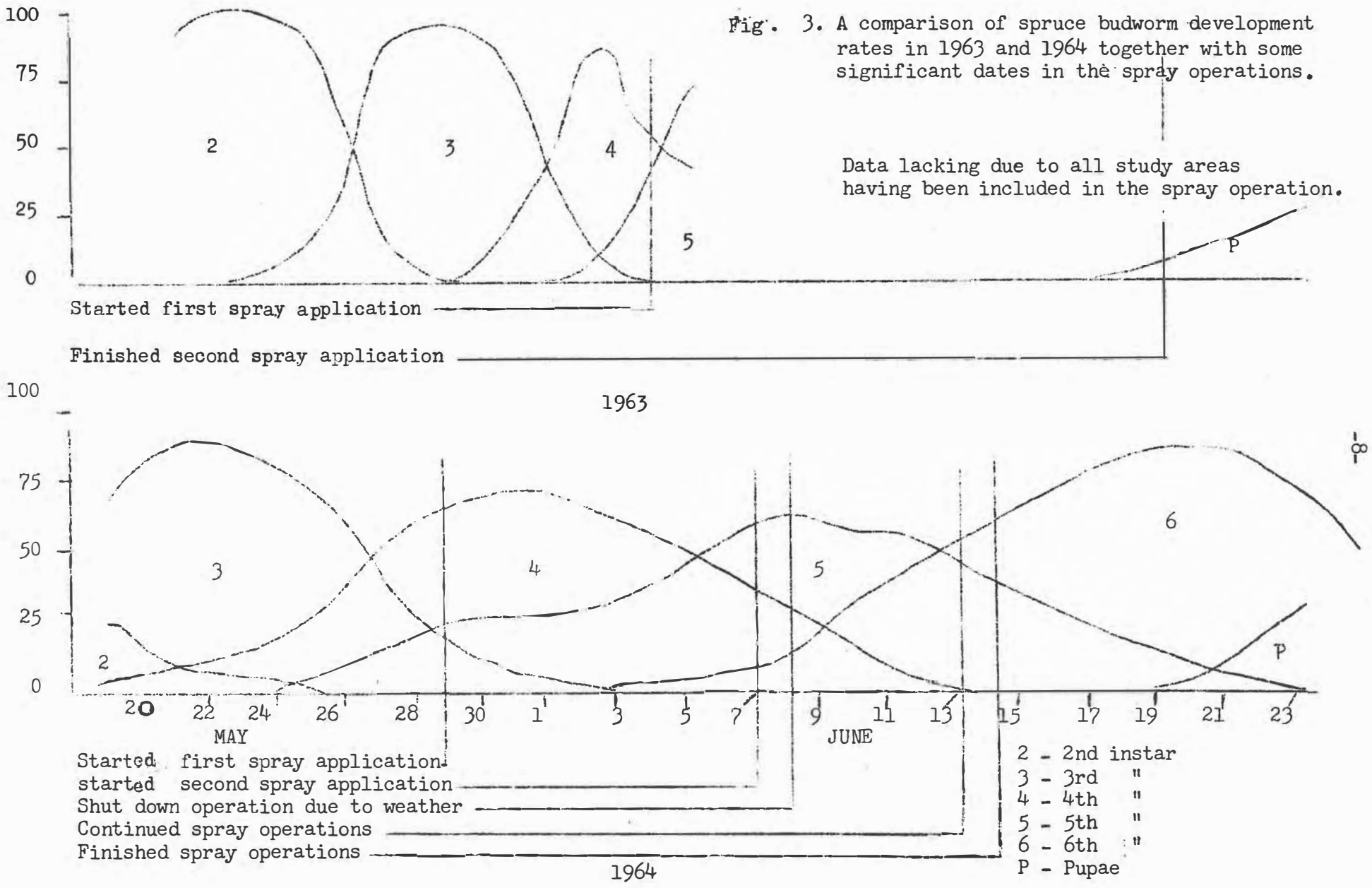


Fig. 3. A comparison of spruce budworm development rates in 1963 and 1964 together with some significant dates in the spray operations.

Data lacking due to all study areas having been included in the spray operation.

Since survival was high in unsprayed areas and 1963 was generally a good year for the budworm (except for the spray operation), the Oxbow area infestation increased four-fold. Unsprayed areas of lighter infestation saw a nearly two-fold increase in budworm populations (Table 4., 1963 Budworm Report). This brought some previously marginal areas into the 1964 spray program together with the Oxbow area and certain spots about the edge of the 1963 spray boundary.

In 1964, operations began on May 29th, but about 25% of the larvae had already reached the 5th instar. Since the area to be sprayed was smaller, the second application began earlier than in 1963 and parts of the Oxbow area were sprayed the second time by the 7th and 8th of June. This was unfortunate, since once the area had been released for spraying, the seasonal development slowed. However, after part of the Oxbow area was completed, a period of unfavourable spraying weather intervened and delayed operations until the 13th. By then, budworm development, although proceeding slowly, had reached a more suitable condition for greater kill. The data indicate that control was more satisfactory in all areas sprayed later. Thus the poorer overall control seems to be related to the earlier spray application in part of the Oxbow area.

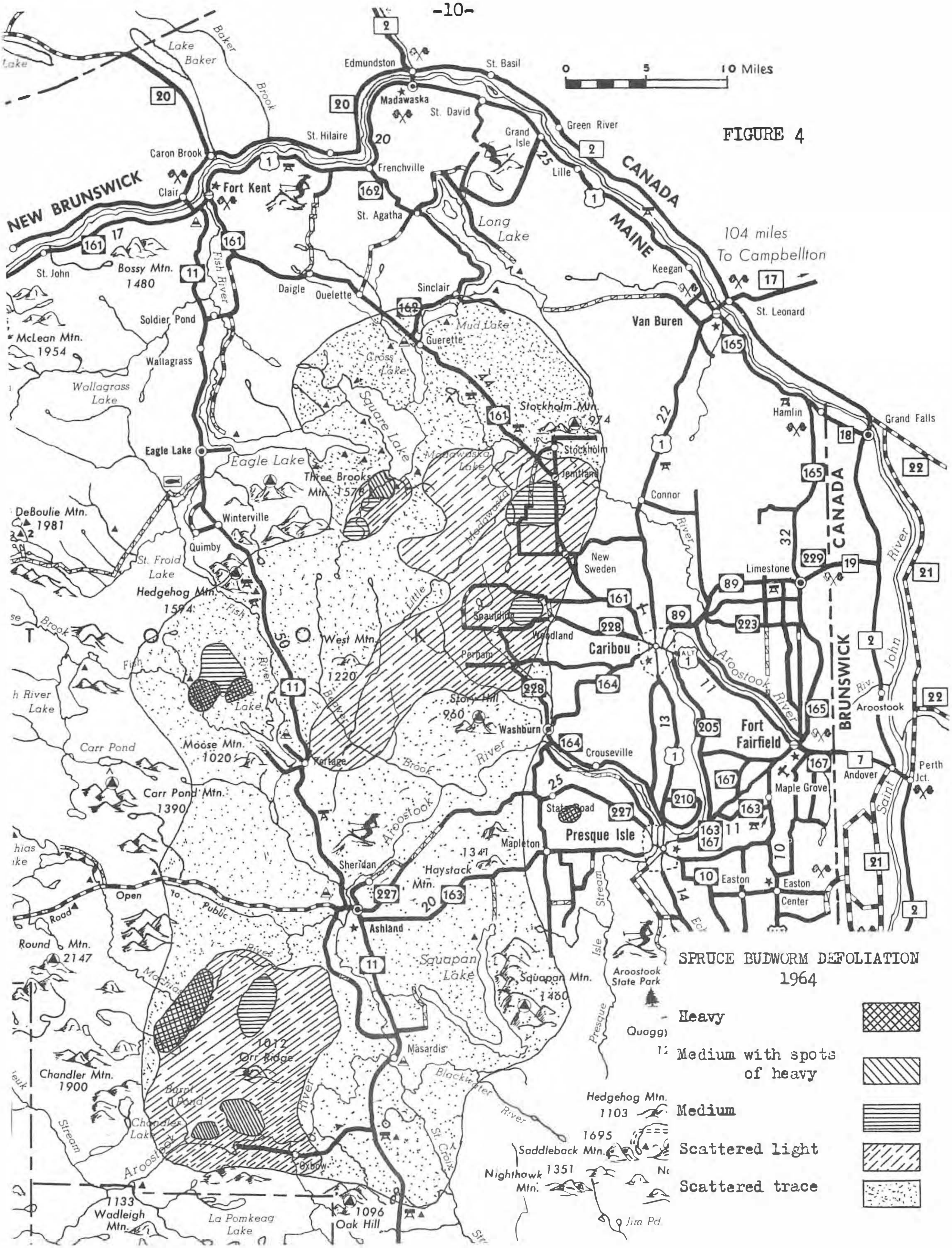
5. MALATHION TESTS

Some experimental spraying was done to determine the effectiveness of Malathion against the spruce budworm. These studies were under the direction of Dr. John Dimond of the University of Maine with the cooperation and assistance of the Maine Agricultural Experiment Station, American Cyanamid Co., and the Maine Forest Service. Laboratory space was made available by the Maine Forest Service which also assisted the project by arranging the spray areas and providing equipment and facilities for the actual spraying. Principal site for the tests was the area surrounding Fogelin Pond in New Sweden. Indications are that the results did not equal those normally experienced with DDT. In connection with this project the Conservation Foundation (New York City) is financing a two year study of the reactions of aquatic insects to Malathion.

6. DEFOLIATION BY SPRUCE BUDWORM IN 1964

Due to a number of operational problems it became impractical to carry out the traditional aerial survey. Instead defoliated areas were sketch-mapped from the air and greater reliance was placed on ground observations made during the egg mass survey. Data from both aerial and ground observations were combined in preparing the map presented as Figure 4.

FIGURE 4


NEW BRUNSWICK
CANADA
MAINE
0 5 10 Miles
104 miles To Campbellton
Fort Kent
Madawaska
Van Buren
Caribou
Presque Isle
Fort Fairfield
Ashland
Washburn
Limestone
Eagle Lake
Square Lake
Long Lake
Squapan Lake
Aroostook State Park
SPRUCE BUDWORM DEFOLIATION
1964
Heavy
Medium with spots of heavy
Medium
Scattered light
Scattered trace

Most of the defoliation occurred in scattered spots in the Oxbow area, near the Forks of the Machias, in spots west of Masardis and south of the Machias River, northwest of Portage Lake between Fish River and Mosquito Brook, southwest of Square Lake, and around the south end of Madawaska Lake. Several spots of defoliation, some heavy, occurred in isolated stands in the farming country from Mapleton northward to Stockholm.

The Oxbow area defoliation is largely within the 1964 spray area and is very scattered and irregular, light to medium with some small spots of medium to heavy. Much of it probably represents defoliation prior to spray application or misses during the first application. For the first time aerial observations revealed light defoliation south of the Aroostook River, southwest of the Salmon Pool, outside of any previous spray application.

Near the Forks of the Machias, an area of medium to heavy defoliation was seen from the air. This area is partly inside the 1963 and 1964 spray areas but mostly just outside these areas to the west.

South of the Machias River and west of Squapan Junction and Masardis, in T10R6, there were considerable areas of light and medium defoliation, largely in areas surrounded by the 1963 and 1964 apray areas and around Carry Brook.

Northwest of Portage Lake, from the Fish River near its junction with Fewes Brook, northeasterly toward Mosquito Brook, some areas of medium to heavy defoliation were seen within the 1963 spray area. Much of this falls within a spray block that received only a single, half dosage treatment.

Southwest of Square Lake, small areas of medium to heavy defoliation were spotted, probably reflecting damage prior to the 1964 spray application.

Areas of light and light to medium defoliation surrounded the south end of Madawaska Lake, outside the 1963 spray application area.

Medium and medium to heavy defoliation were noted in the 1964 Malathion experimental area near Fogelin Pond in New Sweden.

From Mapleton northward toward Stockholm several more or less isolated stands exhibited medium and sometimes heavy defoliation. Such stands are commonly surrounded by agricultural lands and have not therefore been scheduled for treatment in past projects.

Previously defoliated areas in the Beaver Brook country southward to Ashland showed only trace to light defoliation.

Recovery was especially noticeable in the areas surrounding and east of Squapan Lake. Here only a few spots of trace defoliation were noted.

The scattered and less serious nature of the 1964 defoliation as compared to recent past years reflects the success of the two year spray program as well as a generally less favourable season for the spruce budworm. Such defoliated areas as remain are not as well defined as in the past and are generally quite small. There are no extensive areas where tree mortality is likely.

7. SPRUCE BUDWORM AT LIGHT TRAPS IN 1964

Light traps were operated at 25 locations in Maine during 1964. All material was sent to Augusta for examination. Results are shown in Table 4. There were no unusual catches. The traps at Cross Lake and DeBoulie Mtn. are near the presently infested area and the budworm captured are no more than would be expected. Budworm were especially rare in catches from the western parts of the State.

An unusual catch of about 218 budworm moths was taken on the night of July 21-22 from a trap in Dover, New Hampshire. A few lingering strays were taken on the following nights. The source of this flight is unknown.

8. THE EGG MASS SURVEY

The 1964 egg mass survey showed that the goals of the 1964 spray operation had been attained. Budworm populations had been greatly reduced in the Oxbow area, protecting weakened trees and protecting the 1963 spray area from the possibility of re-infestation. However, some small separate spots of medium and medium to heavy populations have been identified in the Oxbow area and one medium to heavy spot has been found just to the southwest of the area, south of the Aroostook River.

Heavy populations exist on small scattered fir trees south of the Oxbow post office in areas that have never been treated.

An area west of the Forks of the Machias, largely just outside of the 1963 and 1964 spray areas to the west supports medium to heavy populations. A somewhat heavier infestation exists near Carry Brook, east of Grassy Landing and Punchard Brook. Further east, a medium population was revealed at Trout Brook in Garfield.

Heavy egg mass collections separated by light collections came from an area northwest of Portage Lake revealing scattered heavy budworm populations from the junction of Hewes Brook with the Fish River northeasterly toward Mosquito Brook.

Some medium and medium to heavy collections came from an area southwest of Square Lake, along Goddard Brook.

Light to medium populations exist in the areas surrounding the south part of Madawaska Lake and some medium to heavy populations were found around and in the Fogelin Pond Experimental Area.

Heavy egg mass collections came from some of the scattered stands in the agricultural lands to the east of the wooded areas.

TABLE 4. SPRUCE BUDWORM IDENTIFIED FROM LIGHT TRAP COLLECTIONS DURING 1964

Dates of Collection*

LIGHT TRAP LOCATION	JULY																			
	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	29
Lower Cupsuptic T4R3											1									
Kingfield																				
Eustis																				
Pittston T2R4 NBKP																				
Dennistown			1										6							
T5R16 WELS Russell Mtn.																				
T8R19 (St. Cyprien)									1		1									
T13R12 Round Pond Mt.																				
T15R13 Big Black River									1											
T8R13 Tramway																				
T18R12 Rocky Mtn.						1					2			5						
T17R11 Dickey									1		2			1	1		2			
St. Francis											1			2						
T11R8 Round Mtn.																				
T17R5 Cross Lake					2		10	7	9	36			1	3						
T15R9 DeBoulie Mtn.				1			3	6	2		5	7	2		1	1				1
T9R5, Oxbow Road										1	1							1		
Greenville, Fish Hatchery																				
T3R12 Chesuncook Dan																				
Long A (Millinocket)																			1	
Mount Chase, Shin Pond	1							1		1										
Topsfield																1				
Enfield	1	3	2		3	1								1						
Dennysville	1					1														
Wyman T4R3				4																

*For example, July 9 means the night of July 8-9

Elsewhere egg mass collections revealed uniformly light populations with many collections yielding no egg masses. The area around and to the east of Squapan Lake yielded few egg masses. No egg masses were found in collections from outside the regions of recent concern.

In general, the 1964 egg mass survey reveals lighter and less serious or continuous budworm populations than have existed for several years, reflecting the results of two successive successful spray operations.

The egg mass survey results are outlined on the map presented as Figure 5.

In Table 5, the apparent trends in egg mass populations are shown. Within the area sprayed in 1963, a slight increase in populations is revealed. However much of this increase is attributable to the fact that a few spots in one corner of the 1963 spray area had heavy populations. The area in general shows little increase in infestation. Most parts of the 1963 spray area yielded fewer egg masses than in 1963. There has been a slight decrease in budworm egg numbers in the lightly infested areas compared with 1963. The Oxbow area shows a considerable decrease in infestation as a result of the 1964 spray operation.

The egg mass survey confirmed the results of other surveys and observations made during the 1964 season. The spruce budworm infestation seems to be at a rather low ebb compared to recent past years. Only scattered spots support heavy populations.

9. NATURAL CONTROL FACTORS

Weather conditions in 1964 seem to have been less favourable to budworm survival compared to 1963. After an early start during a period of warm, pleasant weather in May, development slowed and was more prolonged (Figure 3). This slowing was especially noticeable during the early days of June and complicated the 1964 spray program as mentioned earlier. Survival of spruce budworm larvae between the early larval period and the late larval-pupal period as indicated by survey collections at these times was lower in 1964 (Table 1., unsprayed area, balsam fir). Somewhat poorer seasonal survival is also reflected in the egg mass survey (Table 5., unsprayed areas).

Parasitism of the spruce budworm was studied as usual by dissecting larvae from the early larval collections and rearing larvae and pupae from the late larval-pupal collections. Results of this dissection and rearing work are presented as Tables 6 and 7. Both early larval parasitism and late larval parasitism have increased over 1963. The pupal parasites, Itoplectis, Ephialtes, and Phaeogenes were not recovered in the 1964 rearing work. This was quite likely due in part to the fact that the late larval-pupal survey was made somewhat earlier in relation to the seasonal development.

Aggregate early and late larval-pupal parasitism was calculated to be 30.1%, higher than in 1963, even without the usual pupal parasites.

FIG. 5

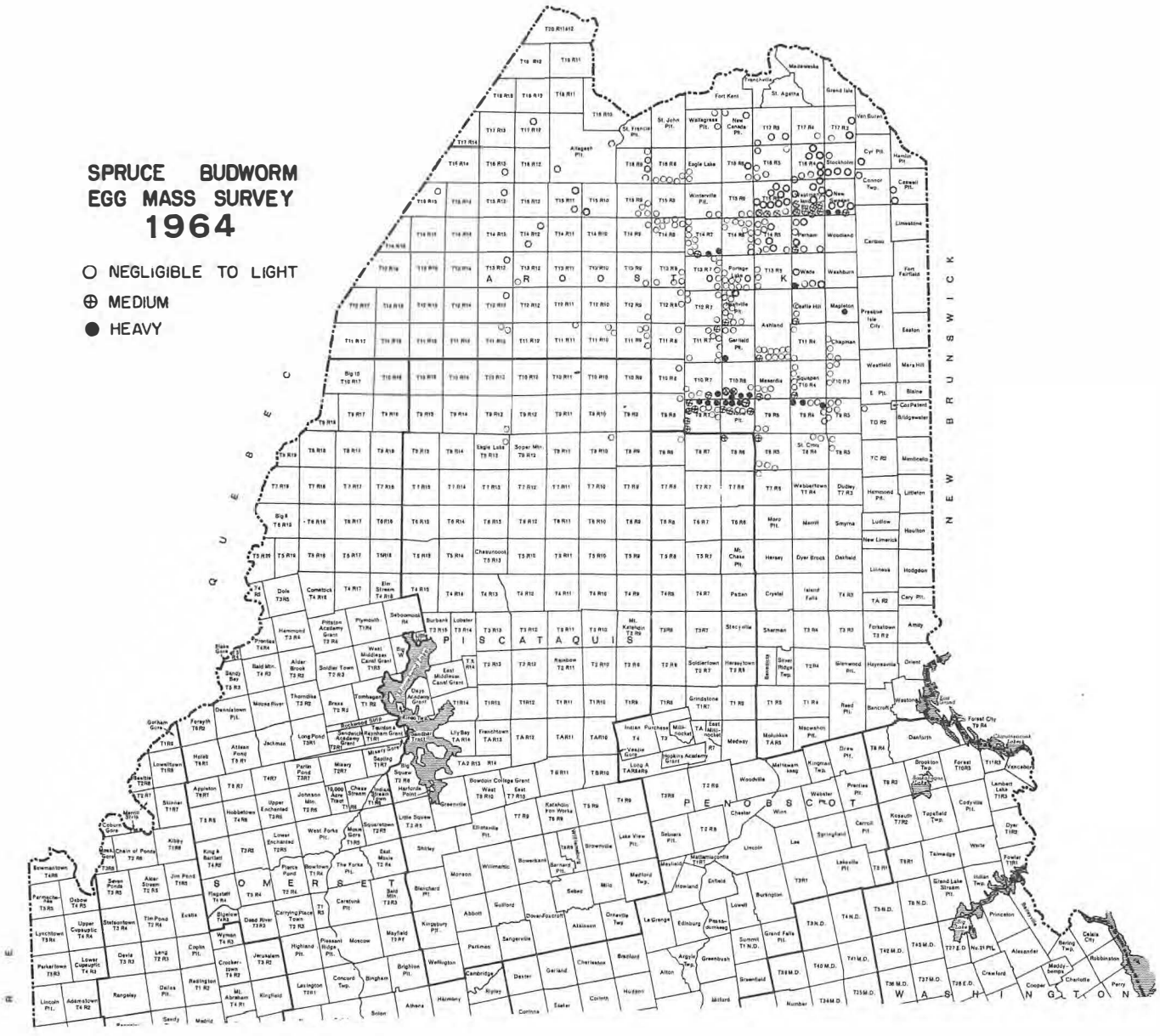

SPRUCE BUDWORM
EGG MASS SURVEY
1964
O NEGLIGIBLE TO LIGHT
⊕ MEDIUM
● HEAVY
QUEBEC
NEW BRUNSWICK
AROOSTOOK
PISCATAQUIS
PENOBSCOT
SOMERSET
WASHINGTON

TABLE 5. Trends in spruce budworm egg mass populations 1961-1964 in areas in and surrounding the 1963 spray operations.

	Average number of egg masses per 15-inch fir tip (number of sample points indicated in brackets)			
	1961	1962	1963	1964
1. Areas sprayed in 1963	1.71 (166)	1.43 (134)	0.15 (199)	0.23 (125)
2. Areas unsprayed in 1963 (except Oxbow Area)	0.19 (187)	0.09 (180)	0.16 (175)	0.14 (143)[1]
3. Oxbow Area[2]	0.56 (15)	0.33 (19)	1.35 (20)	0.34 (21)

	Ratio number of egg masses (Trend Index)		
	1962/1961	1963/1962	1964/1963
1. Areas sprayed in 1963	0.84	0.10	1.53
2. Areas unsprayed in 1963	0.47	1.78	0.88
3. Oxbow Area	0.59	4.09	0.25

1. Not including those areas outside the Oxbow Area that were sprayed in 1964.

2. Sprayed in 1964.

TABLE 6.

SPRUCE BUDWORM PARASITES PRESENT IN EARLY LARVAL COLLECTIONS

No. of Collections	223
No. of larvae dissected	8371
No. of *Apanteles* sp. present	1234
No. of *Glypta* sp. present	364
No. of *Horogenes* sp. present	43
No. of unidentified parasites	2
Total No. of parasites	1643
Percent parasitized	19.6
(percent parasitized in 1963	14)

TABLE 7.

PARASITES OF LATE LARVAE AND PUPAE

No. of collections	103
Corrected[1.] number of larvae and pupae reared	2511
No. of *Itoplectis* sp. recovered	0
" " *Ephialtes* " "	0
" " *Phaeogenes* " "	0
" " *Meteorus* " "	117
" " *Actia* " "	20
" " *Agria* " "	10
" " *Aplomya* " "	9
" " *Lypha* " "	83
" " *Omotoma* " "	24
" " *Phorocera* " "	7
" " *Phryxe* " "	47
" " Undetermined	12
Total No. of parasites recovered	329
Percent parasitized	13.1
(Percent parasitized in 1963	8.7)

1. Correction is made by discounting early larval parasites recovered and those dead of unknown cause or missing during rearing.

Parasitism of the spruce budworm eggs showed a definite increase in 1964. The common egg parasite Trichogramma minutum Rly. was frequently found infesting the egg masses collected. This parasite has remained at relatively low levels from year to year until the unusual increase of 1964. It has now reached the highest level recorded in these surveys since about 1950. A study of this insect is now in progress. Of 7219 eggs examined from 481 egg masses, 1975 or 27.4% were parasitized. However, the effectiveness of T. minutum as a budworm parasite may be limited by its dependence on alternate hosts.

10. EXPECTED 1965 CONDITIONS

After consideration of the 1964 data and field conditions, entomologists of the Maine and U.S. Forest Services recommended that there be no treatment in 1965.

It was noted that budworm populations had not risen appreciably in the general area treated in the very successful 1963 spray operation. The 1964 operation had been essentially a "mop-up", treating principally the Oxbow Area which was removed from the 1963 program in order to test Bacillus thuringiensis, and in addition treating certain areas near the edge of the 1963 operation where budworm populations had increased due to the favourable weather and other conditions.

Certain small, scattered areas, both within and just outside the main infestation remain as problems however. Such areas, because of their small, irregular and poorly defined area, mixed with hardwood ridges and areas of unfavourable tree growth for budworm, are most difficult to delineate for spray purposes. Certain trees are in poor condition but the majority are in good condition and are in no immediate danger.

While 1963 was a good year for the spruce budworm and populations increased in all areas not subject to the spray program, 1964 was less favourable and remaining populations were reduced (Table 1., unsprayed areas, 1964 vs 1963 and Table 5). If 1965 proves to be an unfavourable year also, heavier populations in these scattered areas could be expected to decline, even without spraying. If conditions in 1965 prove to be as suitable for budworm increase as 1963, then low populations throughout the infested area could increase sufficiently to be of concern in 1966 regardless of whether or not the small scattered areas are treated in 1965.

11. SUMMARY

1. A control project of 58,100 acres was carried out in 1964 to protect trees, reduce the budworm population in the Oxbow area and protect the 1963 spray area from re-infestation. Several small areas were treated as part of the project. The objectives were accomplished.

2. Defoliation was more scattered and less serious in 1964, reflecting the effects of the two-year spray program as well as a less favourable season for the budworm.

3. Scattered heavy populations remain at a number of locations but these are small in acreage and tree condition is generally good.

4. Outside the main infestation area, budworm populations have declined.

5. Less favourable weather conditions and a somewhat higher parasitism rate prevailed in 1964. Egg parasitism was very noticeably higher.

6. No spray program is planned for 1965.

12. CONDITIONS IN ADJACENT CANADIAN PROVINCES

Maritime Provinces[1].

Surveys of spruce budworm egg mass populations throughout New Brunswick in 1964 indicate that there are six major infestation areas in the central part of the Province where severe defoliation can be expected in 1965. The infestations extend from the valley of the St. John River north of Hartland across the Province to the confluence of the Northwest and Southwest Miramichi rivers. The areas total some 1.7 million acres which is approximately the same total area that was infested at this time in 1963.

There are no infestations in Nova Scotia although some defoliation is expected at one location on Prince Edward Island.

Quebec[2].

"The situation of this insect was comparable to that of 1963. Very few larvae were seen in the field and no report of infestation was received. Budworm-killed trees not yet salvaged are the only evidence of the last outbreak and in many areas they are progressively disappearing from sight under dense stands of balsam fir which originated after the recent infestation."

1. Information supplied by D. R. Macdonald, Forest Entomology and Pathology Laboratory, Fredericton, N.B.

2. Information supplied by Rene Martineau, Forest Research Laboratory, Sillery (Quebec), P.Q., from the Forest Insect and Disease Annual Survey Report (Quebec Section).

13. APPENDIX

The spruce budworm field work continues to be the principal project for nearly all of the Maine Forest Service Entomology staff during the months of May, June, July, and part of August. This work is under the direction of John Coughlin who, aided by the suggestions and advice of Maine and U. S. Forest Service personnel has prepared this report.

The actual spray operations, as usual, are under the direct and personal supervision of State Entomologist Robley W. Nash.

Closely involved in the budworm project have been entomologists George LaBonte, Douglas Stark, Louis Lipovsky, and Dr. H. Allen Thomas. Biologist Horace E. Bell, and forest insect rangers James A. Holmes, Frank Manning, George McGinley, Maynard Atwood, Rex McBreairty, Arnold Shaw and Larry St. Peter have spent a large part of the summer field season on the project. Light trap identifications have been made by Dr. A. E. Brower.

From the U. S. Forest Service, Dr. William E. Waters, Gordon Mott of the New Haven Laboratory and Hubbard Trefts of the Amherst Mass. Office have participated with advice, actual field assistance and advice for the Cooperative Report.

The Great Northern Paper Company has continued to make available the very useful portable building used for the Portage field laboratory.

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